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"Emul'tsid ET-2", pp. 6-7.

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(54) CUTTING FLUID FOR MECHANICAL WORKING OF METALS

(57) Abstract

Substance of invention: the fluid includes an emulsifying oil based on mineral oil and an antimicrobial additive, which includes

1,3,5-tri(β-hydroxyethyl)hexahydro-s-triazine, the product of condensation of ethylene glycol and formaldehyde and sodium tetraborate, 2.5-3.5%, a 25% aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate 0.1-0.5%, the product of condensation of monoethanolamine with dimethylolurea 0.1-0.3%, and soda ash 0.1-0.3%, remainder water. 4 tables.

The invention relates to cutting fluids (CF), which can be used for the mechanical working of metals by cutting.

A large number of CF are known, comprising aqueous solutions of concentrates, emulsifying oils, etc. (cf. Entelis S.G. Technological cooling lubricants for working metals by cutting. Moscow, Mashinostroenie, 1985, p. 74).

A CF is known, based on a petroleum oil emulsifying oil with an aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate [1].

However, this CF is not sufficiently effective in regard of its associated properties. Corrosion appears in the course of use.

Closest in technical substance to the CF now proposed is a CF for the mechanical working of metals which is based on an aqueous emulsion of an emulsifying oil - Emul'tsid ET-2 [2].

The CF has the composition, wt.%: Emul'tsid ET-2 emulsifying oil 2.5-3.5, soda ash 0.2-0.3, sodium nitrite 0.2-0.3, remainder water.

However, said CF does not ensure the necessary wear-resistance of the cutting tool and the quality of the machined surface when cutting alloy steels and high-duty cast iron in severe cutting conditions. Furthermore, it has inadequately high microbial and corrosion resistance.

Said disadvantages are eliminated in that a cutting fluid for the mechanical working of metals by cutting, based on an aqueous emulsion of Emul'tsid ET-2 emulsifying oil and soda ash, additionally contains a 25% aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate (aqueous dispersion A-25) and Karbamol-B with the following ratio of components, wt.%:

Emul'tsid ET-2 emulsifying oil 2.5-3.5

soda ash 0.1-0.3

25% aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate 0.1-0.5

Karbamol-B 0.1-0.3

remainder water.

Emul'tsid ET-2 (TU 38.301-40-9-90) comprises emulsifying oil ET-2 (in accordance with TU 38.101599-76) based on mineral oil with an antimicrobial additive which includes the product of condensation of ethylene glycol and formaldehyde, 1,3,5-tri( $\beta$ -hydroxyethyl)hexahydro-S-triazine and sodium tetraborate.

Aqueous dispersion A-25 comprises the product of the copolymerisation of vinyl chloride with vinyl acetate (TU 6-01-1181-79) and is used in the production of paints and of magnetic and ferromagnetic tapes as an impregnant. Aqueous dispersion A-25 is also known as an anti-wear additive for CF.

Karbamol-B (the product of condensation of monoethanolamine with dimethylolurea, TU 6-5011400-2-86) is used as an additive for protection against microbial spoilage.

The effectiveness of the new CF composition is achieved due to the combined action of the above-mentioned components, which provide the composition with a synergistic effect due to the formation on fresh surfaces in the cutting zone of thermodynamically stable films of complex organometallic compounds containing oxygen, chlorine and nitrogen, as a result of which cutting tool life is increased, machining quality is improved, and CF microbial and corrosion resistance in the course of prolonged use are increased.

Preparation of an emulsion of the new composition was performed in the following manner.

A vessel was filled to 1/3 of its volume with water (40-50°C), soda ash was added with stirring and was stirred until fully dissolved, then Carbamol-B additive was added and was stirred for 5 min. An emulsifying oil paste was prepared in a separate vessel, for which purpose stirred emulsifying oil in the required amount was fed from a storage vessel into the vessel for preparation of the emulsifying oil paste, and water (30-40°C)

was added with mechanical stirring to form an emulsifying oil paste mass of thick soured cream consistency. The tank with the prepared anticorrosion solution was filled with water (30-40°C) to 2/3 of its volume and, with mechanical or air stirring on, the prepared emulsifying oil paste was poured in, after which the required amount of A-25 aqueous dispersion was introduced, and the volume of the prepared emulsion was adjusted to the required volume with water (30-40°C) and stirred for 16 min., after which the stirring was stopped. A sample of the emulsion was taken for checking and, on compliance of the physico-chemical characteristics with the requirements of GOST 6243-75, was used in production.

In order to perform comparative tests, 5 samples of the CF were prepared, and these were checked for compliance of the physico-chemical characteristics. The results are presented in Table 1.

The compositions of the CF samples are shown in Table 2.

Composition 5 was, however, excluded from further tests, since irritation of the skin of workers hands is observed.

Compositions 2, 3 and 4 of the CF now proposed were tested in comparison with known CF composition 1, containing, wt.%: Emul'tsid ET-2 emulsifying oil 2.5-3.5, soda ash 0.2-0.3, sodium nitrite 0.2-0.3, remainder water.

The tests were performed on the operations of thread cutting and drilling. For thread cutting, the CF tests were performed in a model 2S170 vertical drilling machine. An M 85 H6H thread was cut in blanks of steel 40 Kh with hardness  $H_B = 285$  (according to drawing  $H_B = 241-285$ ) with a sulphur content of 0.0015 wt.% (according to drawing not more than 0.043 wt.%) with taps of high-speed steel R6M5.

Cutting conditions: cutting speed  $V_{cut} = 2.3$  m/min, feed  $S = 1.25$  mm/rot, machine time  $T_{mach} = 0.475$  min. CF effectiveness was assessed from the tap life before regrinding in parts, i.e. before a flank wear of  $0.5 \mu\text{m}$ . The tests were repeated 10 times for each CF composition and the mean tool life was found.

For drilling, CF tests were performed in a model AM-8946 standard-unit drilling machine.  $\varnothing 11.5$  mm holes were drilled in blanks of Vg-50 high-duty cast iron,  $H_B = 210$  (according to drawing 196-210) using GOST 2301-0034 drills of R6M5 steel.

Cutting conditions: cutting speed  $V_{cut} = 21$  m/min, feed  $S = 0.32$  mm/rot, machine time  $T_{mach} = 0.9$  min. CF effectiveness was assessed from drill life before regrinding, i.e. before a flank wear of  $0.9 \mu\text{m}$ , in parts.

The results of the tests are presented in Tables 3, 4.

As is evident from Tables 3, 4, the use of the CF now proposed of composition 4 provides a 1.8-fold increase in tool life when cutting threads, and a 1.6-fold increase when drilling.

Here, surface roughness is reduced from 6 to  $2.5 \mu\text{m}$  when thread cutting and from 1.4 to  $0.32 \mu\text{m}$  when drilling.

Furthermore, the CF now proposed is significantly different in corrosion resistance and bactericidal stability: corrosion resistance is increased 3-fold, and microbial resistance 2-fold compared to the known CF.

#### C l a i m

CUTTING FLUID FOR MECHANICAL WORKING OF METALS, containing water, soda ash and an emulsifying oil based on mineral oil and an antimicrobial additive which includes 1,3,5-tri-( $\beta$ -hydroxyethyl)hexahydro-s-triazine, the product of condensation of ethylene glycol and formaldehyde and sodium tetraborate, characterized in

that the fluid additionally contains a 25% aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate and the product of condensation of monoethanolamine with dimethylolurea, with the following ratio of components, wt.%:

Emulsifying oil based on mineral oil and an antimicrobial additive which includes 1,3,5-tri( $\beta$ -hydroxyethyl)hexahydro-s-triazine, the product of condensation of ethylene glycol and formaldehyde and sodium tetraborate - 2.5-3.5

25% Aqueous dispersion of a copolymer of vinyl chloride with vinyl acetate - 0.1-0.5

The product of condensation of monoethanolamine with dimethylolurea - 0.1-0.3

Soda ash - 0.1-0.3

Water - remainder.

Table 1

Characteristics	Norm	Test method
Appearance	Milk-coloured homogeneous liquid	GOST 6243-75, section 1
Content of organic products	2.5-3.5	Salting out emulsions with a mixture of a solution of ammonium sulphate and sodium chloride (1:1)
Stability of emulsion: over 1 h, %	Not more than 1.0	GOST 6243-75, section 3
pH of emulsion	9.0-9.6	GOST 6243-75, section 4
Corrosivity of emulsion relative to cast iron sg-18	Emulsion must not cause corrosion on plate of grade 18 grey cast iron GOST 26358-84 over 4 h	GOST 6243-75, section 2
Total alkalinity, calculated as soda ash, g/l	2.0-3.0	Titration with hydrochloric acid
Microbial resistance of CF, points: freshly prepared during use	0 not more than 2	VNIIPK Neftekhim method using 2,3,5-tetrazolium chloride

Continuation of Table 4

1	2	3	4	5
Corrosion resistance: after 1 month	Not maint.	Not maint.	Maint.	Maint.
after 2.5 months	Not maint.	Not maint.	Maint.	Maint.
after 3 months	Not maint.	Not maint.	Not maint.	Not maint.